DEVELOPMENT OF PICK AND PLACE SYSTEM USING IRB 1400 ROBOT

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"I hereby declared that this thesis titled 'Development Pick & Place System using IRB 1400 ABB Robot' is the result of my own effort except as clearly stated in references the source of reference".

Signature : _____

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Date : 28 APRIL 2006

Dedicated to my beloved mother, father, brothers and sister and to all Malaysians.
Aja!!! Aja!!! Fighting!!!

ACKNOWLEDGEMENT

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ABSTRACT

Many robots have been built for manufacturing purposes and can be found in factories around the world .The idea behind this project is to reduce the utilization of human energy especially in manufacturing industry. The project involves of development pick and place system a using ABB IRB 1400 industrial robot. In this project, the IRB 1400 robot was program to perform pick and place task. The robot was equipped with robotic sensor to detect the work pieces. Using the ABB robot's Rapid software, the program was downloaded to the robot controller, S4Cplus. By teaching the robot points with the Teach Pendants, we can execute the ABB robot program sequences. In the manufacturing system, conveyor work as a method of work part delivery. Model of small conveyor was constructed to delivery the work pieces from the incoming part. The sensors were mounted to the conveyor, which is to sense the incoming material and also to control the operation of the conveyor motor. The robot that was programmed will pick and place the material in the outgoing part. The operation of the system working continuously since the sensor detected the incoming material.

ABSTRAK

Dewasa ini, pelbagai jenis robot telah banyak di aplikasikan di dalam industri pembuatan dan boleh di dapati di kilang-kilang di seluruh dunia. Matlamat sebenar projek ini ialah untuk mengurangkan tenaga kerja manusia terutamanya di dalam bidang industri pembuatan. Projek ini melibatkan pembinaan sebuah system mengambil dan meletak barang dengan menggunakan robot industri iaitu ABB IRB 1400.Di dalam projek ini, robot IRB 1400 akan di program untuk menjalankan proces mengambil dan meletak barang. Robot akan beroperasi bersama sensor untuk mengesan kehadiran objek. Dengan menggunakan *Software RAPID Language*, program yang telah siap di program akan di muat turun ke dalam robot controller iaitu *S4Cplus*. Robot akan di ajar untuk bergerak mengikut titik yang telah di tetapkan dengan menggunakan *teach pendant.*Di dalam sistem pembuatan, *conveyor* bekerja sebagai sistem penghantaran. Sebuah model *conveyer* telah di bina untuk membawa objek daripada bahagian barangan masuk. Sensor akan dipasang kepada *conveyer* untuk mengesan kehadiran objek dan mengawal operasi motor *conveyer*. Robot di program untuk mengambil dan meletakkan barang tersebut ke dalam bahagian barangan keluar. Sistem ini beroperasi secara berterusan sehingga tiada objek yang akan di kesan oleh sensor.

TABLE OF CONTENTS

LIST OF TABLE

LIST OF FIGURE

GLOSSARY OF ABBREVIATIONS

AGV'S	-	Automated Guided Vehicles
CMM's	-	Co-ordinate Measuring Machine
ASRS's	-	Automated Storage and Retrieval Systems
DC	-	Direct Current
ABB	-	ASEA Brown-Boveri
ISO	-	International Organization for Standardization
OS	-	Operating System
PLC	-	Programmable Logic Control
TCP/IP	-	Transport Control Protocol/ Internet Protocol
TCP	-	Tool Center Point

LIST OF APPENDIXES

CHAPTER I

INTRODUCTION

This chapter describes about the project's introduction. It consists of overview of the project, the project aim, objectives and scopes of the project.

1.1 Robot Overview

There are many definitions of robots. It seems to be of difficulty to suggest an accurate meaning for the word robot, that there are various definitions of this word, different according to the points of view. Some view a robot through the aspect of reprogrammability while others more concern on the manipulation of the robot, behavior, intelligence and so on. The British Robot Association (BRA) defines robot as a programmable device with a minimum of four degrees of freedom designed to both manipulate and transport parts, tools or specialized manufacturing implements through variable programmed motion for the performance of the specific manufacturing task [1].

While the Robotic Institute of America, on the other hand defines the robot as a reprogrammable multifunctional manipulator designed to move material, parts, tools or specialized devices through variable programmed motion for the performance of a variety of tasks [2].

Based on the definition of robot by the two institutes, it can be concluded that a robot must be an automatic machine and be able to deal with the changing information received from the environment.

1.1.1 Word History

The word *robot* comes from the Czech word *robota* (compare with the Russian rabota for "to work") meaning "drudgery", "servitude", or "forced labor", especially the so-called "labor rent" that survived in the Austro-Hungarian Empire until 1848. Isaac Asimov, coined the word robotics as the science of the study of robots, in his science fiction stories about robot in 1940s.Where in Europe, robotics is define as ‘the science of robotology’ and robotology is defines as ‘the means by which robot machines are put together and made to work’.

Many people think of robotics as a single area of technology, but in fact robotics encompasses such diverse areas of technology as mechanical, electrical, electronics, systems, computer, hardware and software and a host of other advanced technology.

1.1.2 The Distinction between 'Automation' and 'Robotics'

'Robots' is only a small sub-set of the technologies covered by the much broader term Automation'. 'Automation' refers to a mode of operation in which any machine or piece of equipment is capable of working without human intervention. Originally, automation was limited in its potential, as automatic machines could only replace physical effort and not mental effort.

Robots are just one example of flexible automation. Other examples in the industrial sector are NC machine tools, automated assembly machines (including automated component insertion machines), automated guided vehicles (AGV's) automated storage and retrieval systems (ASRS's), co-ordinate measuring machines (CMM's) laser / plasma / water jet cutting machines etc.

The terms 'robot' and robotics' both therefore originated in science fiction and the original perception was one of human-like machines or androids. In popular culture, and particularly in films, robots are often considered to have all the human attributes with some capabilities considerably enhanced over that normally found in humans, but in reality current technology is not yet able to match this vision.

1.2 IRB 1400 Industrial Robot

There are many types of robot in this world. In this project, the industrial robot IRB 1400 has being chosen to doing the pick and place task. The robot has being program to doing the task given. The robot is well-proven in arc welding, material handling and process applications with a total of 10,000 installations since 1992. It delivers plenty of performance for the money, ensuring short payback times.

The handling capacity is 5 kg, plus a unique 18 kg supplementary load on the upper arm. Superior levels of control and path-following accuracy provide excellent work quality. The ability to adjust process speed and position means you achieve optimum manufacturing accuracy with little or no rejects. IRB 1400 is known for its stiff and robust construction. This translates into low noise levels, long intervals between routine maintenance and long service life. The robot has a large working area and long reach. The compact design of IRB 1400 is very slim wrist and high performance operation even in difficult and restricted locations.

1.3 Project Aim

The IRB 1400 is an industrial robot, designed specifically for manufacturing industries that use flexible robot-based automation. This project basically to developed the Pick and Place System by using IRB 1400 robot that will implement in industry.

1.4 Objective

The main objective of this project was to design the pick and place program system by using the IRB 1400 robot. There are two secondary objectives to be achieved in order to achieve the main objective stated above. The two secondary objectives were discussed in the following paragraph.

The first objective was to detect the following object by using proximity sensor that had being integrated with the robot.

The second objective was to design and programs the controller of the IRB 1400 by using RAPID languages. In this language, the program for pick and place task was written and loaded to the robot controller S4Cplus.

1.5 Scope Of The Project

The scope of the project includes wiring the I/O Digital Input of the controller in order to integrate the sensor within the robot. The robot was programmed to wait the signal value from the sensor. The robot continued the following instruction when the signal value was correct. Integration between sensor and DC motor was also concentrated in development of this system. The function of relay and the circuitry of

Control Panel Box also were implemented in the project. Finally, the system was combined together to complete the development of the system.

CHAPTER II

LITERATURE REVIEW

This chapter represents several important issues related to ABB industrial robot and its associate technologies in the industries.

2.1 Industrial Robot

An industrial robot is officially defined by ISO as an automatically controlled, reprogrammable, multipurpose manipulator programmable in three or more axes. The field of industrial robotics may be more practically defined as the study, design and use of robot systems for manufacturing.

Typical applications of industrial robots include welding, painting, ironing, assembly, pick and place, palletizing, product inspection, and testing, all accomplished with high endurance, speed, and precision. Manufacturers of industrial robots include ABB (ASEA Brown-Boveri), Intelligent Actuator, Adept, Epson Robots, and Yaskawa-Motoman.

ABB is a leading supplier of robots and automation for automotive, manufacturing and the consumer goods industry. ABB produced its first robot in 1974. At that time, the

company's robots were mainly used for machine tending and material handling. Nearly 30 years later, that market accounts for some 30 percent of robots sold worldwide. According to the International Federation of Robotics, welding-spot and arc, particularly in the automotive industry, is today's largest robot application.

2.2 ABB Robot in Manufacturing Field

Many robots have been built for manufacturing purposes and can be found in factories around the world. By using the robots and automation expertise in manufacturing system to pick, pack and palletize a wide range of products and packaging designs with robotic solutions may help the manufacturers more flexibility, reliability of their process and higher uptime.

Now days, changing market requirements for products and packages demands flexible production solutions. The robots will provide solutions to improve our competitiveness, productivity and flexibility. Production lines can be quickly and easily tailored to the changing market demands for our products and packages. Additional products, production lines and functions can be quickly and easily integrated compact than traditional lines. By using robot in production lines also offer substantial space savings.

Figure 2.1 and 2.2 shows the one of types ABB robot in the manufacturing industries. The robot used to move objects one at a time from one location to another with speed and accuracy. Regardless of whether the objects are on moving feeders, placed at random or guided, the robot is both faster and more efficient than any conventional system on today’s market.

Figure 2.1: Arc Welding Process

Figure 2.2: Pick and Place Process

In this project, the ABB IRB 1400 robot is used to complete the pick and place task in the manufacturing system. Figure 2.3 show the one of type ABB robot in the real life manufacturing industries. It shows the operation of the robot in the pick and place system. The ABB robot integrated with the conveyor to pick the boxes on the conveyor and sort the boxes in the outgoing material, as illustrated in Figure 2.4.

Figure 2.3: IRB 6400

Figure 2.4: Boxes in the outgoing material

2.3 Pick, Pack and Palletize for Packaged Food with ABB Robot Solution

Changing market requirements for products and packages, demands flexible production solutions. ABB is the one of leading supplier robot that may provides with the flexibility to pick, pack and palletize a wide range of products and packaging designs with robotic solutions. The inherent flexibility of ABB's solutions mean production lines can be quickly and easily tailored to the changing market demands for your products and packages.

Figure 2.5 shows the ABB FlexPicker robot operation in the packaged food in manufacturing industries.

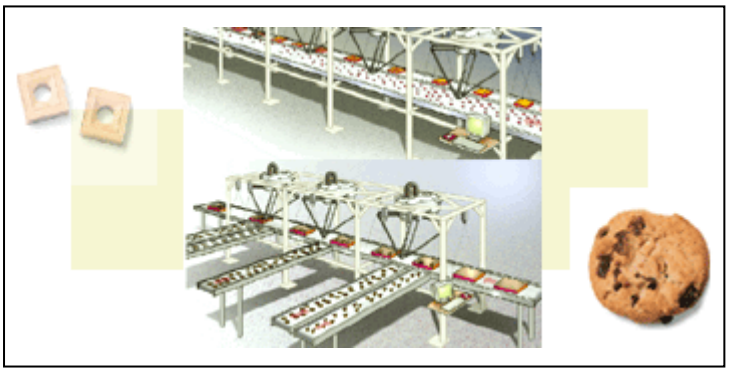

Figure 2.5: ABB FlexPicker in Packaged Biscuits

The ABB FlexPicker robot allows moving objects one at a time from one location to another with speed and accuracy. Regardless of whether the objects are on moving feeders, placed at random or guided, FlexPicker is both faster and more efficient than any conventional system on today's market. Whether it is handling candy, pretzels or syringes, ABB has a robotic solution for manufacturing challenge.

In order to pack products into containers or small sachets into trays or cases as shows in Figure 2.6, ABB offers standard and customized solutions to increase uptime, improve the productivity and throughput and increase the asset utilization. By using robots and automation expertise in food and beverage production, ABB can provide solutions, which will give manufacturers more flexibility, reliability of their process and higher uptime.

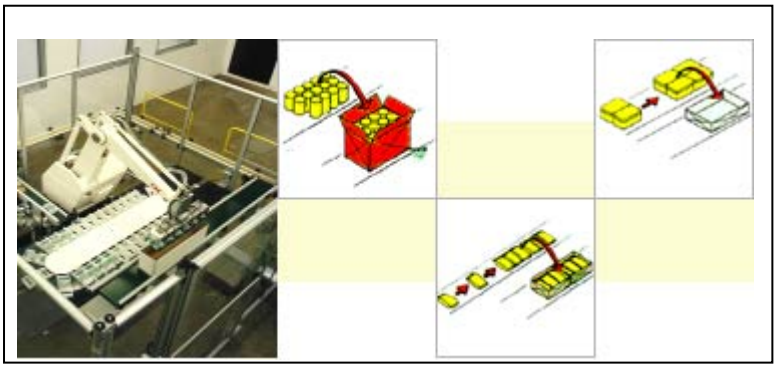

Figure 2.6: Robot pack the product into container

From case packing to labeling to palletizing, ABB robots can handle multiple functions automatically. They're set up to integrate with workflow management, electronic documentation and electronic record systems to improve the access to data, allowing you to track each order through the packaging process.

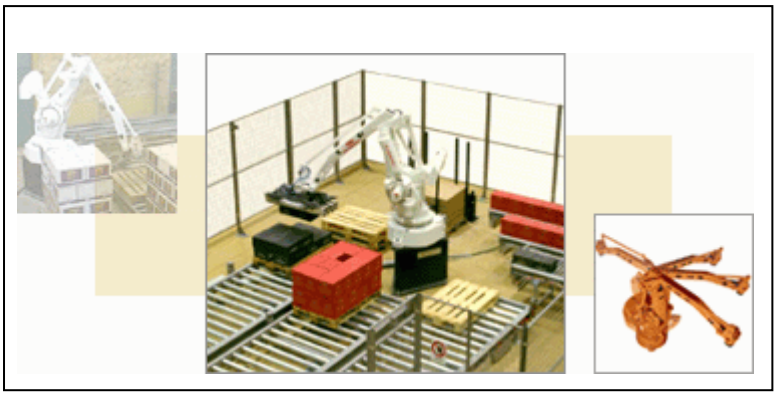

Figure 2.7: ABB robot in palletizing system

Figure 2.7 shows the ABB robot in the palletizing system. These robots deliver flexibility, reliability, and capacity far beyond the limitations of traditional, manual, dedicated palletizes.